(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 898 223 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.02.1999 Bulletin 1999/08

(51) Int Cl.[6]: **G06F 3/147**

(21) Application number: **98306391.8**

(22) Date of filing: **11.08.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **20.08.1997 US 915816**

(71) Applicant: **LUCENT TECHNOLOGIES INC.**
Murray Hill, New Jersey 07974-0636 (US)

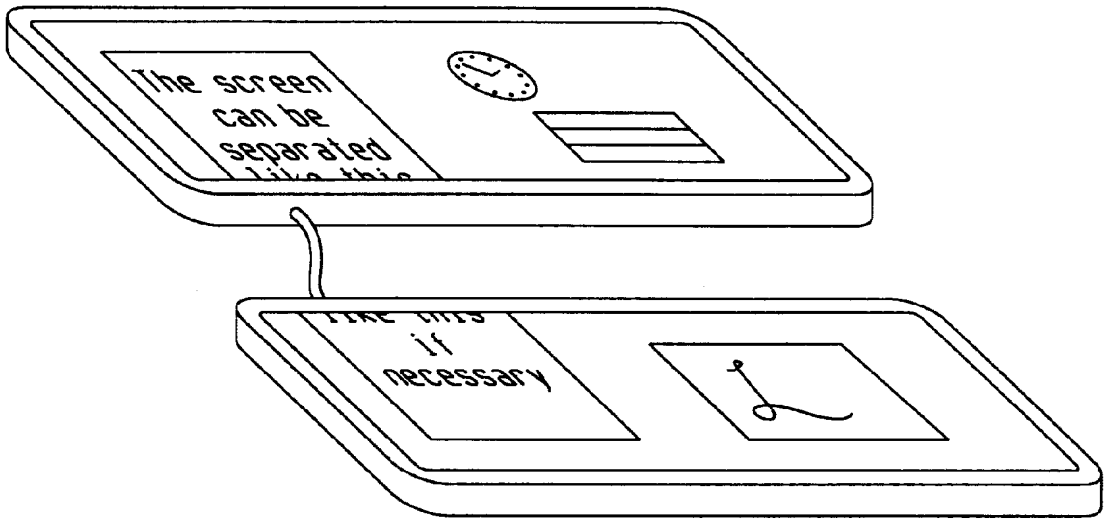
(72) Inventors:
- **Narayanaswamy, Shankar**
  Sunnyvale, California 94086 (US)
- **Rosenthal, Eugene J.**
  Edison, New Jersey 08817 (US)

(74) Representative: **Johnston, Kenneth Graham et al**
Lucent Technologies (UK) Ltd,
5 Mornington Road
Woodford Green Essex, IG8 OTU (GB)

(54) Multi-display electronic devices having open and closed configurations

(57) A portable or other electronic device has two or more display devices or screens that can be used to display different subsets of image signals. The effect is that the device simulates the display capabilities of devices having much larger screens. The device has an open or active configuration, in which the multiple screens are available for displaying image signals, and a closed or inactive configuration, in which some or all of the multiple screens are folded together or otherwise stowed away to reduce the size of the device for storage and/or carrying. By simulating large-display operations, electronic devices according to the present invention are capable of presenting more useable information to the user than is otherwise possible using prior art devices having a single small screen.

FIG. 5



EP 0 898 223 A2

Description

Field of the Invention

[0001] The present invention relates to portable and other electronic devices having displays, such as monitors or screens, for the display of text, graphics, and/or video images.

Description of the Related Art

[0002] One of the drawbacks to portable electronic devices, such as personal digital assistants, cellular telephones, internet access devices, palmtop computers, and even some laptop computers, is that the displays are of limited size. These small displays limit the type of applications that can be run effectively on such devices and/or detract from the quality of the images displayed by such applications. For example, it may be impractical to run software that relies on a graphical user interface (GUI) on a portable device, because the elements of the GUI on the small screen of the portable device will be too small to be adequately visible.

Summary of the Invention

[0003] The present invention is directed to a portable or other electronic device having two or more display devices or screens that can be used to display different subsets of image signals. The effect is that the device simulates the display capabilities of devices having much larger screens. The device has (1) an open or active configuration in which each display device is deployed for displaying a different subset of the image signals and (2) a closed or inactive configuration in which one or more of the display devices are stowed away and unavailable for displaying image signals. Stowing the display devices away, which reduces the size, e.g., footprint, of the device for storage and/or carrying, means folding them together or otherwise making one or more of them unavailable to display image signals for viewing by the user. By simulating large-display operations, electronic devices according to the present invention are capable of presenting more useable information to the user than is otherwise possible using prior art devices having a single small screen.

Brief Description of the Drawings

[0004]

Figs. 1(a) and 1(b) show perspective views of a portable electronic device that functions as a combined cellular phone / personal digital assistant, according to one embodiment of the present invention;

Fig. 1(c) shows a perspective view of a portable electronic device in the open configuration, according to an alternative embodiment of the present invention;

Fig. 2 shows a block diagram of an electronic device, according to one implementation of the present invention;

Fig. 3 shows a block diagram of an electronic device **300**, according to an alternative implementation of the present invention;

Figs. 4-6 shows portable electronic devices, according to possible embodiments of the present invention.

Detailed Description

[0005] The present invention is directed to portable and other electronic devices that have two or more display devices, e.g., screens, where each display device is adapted to display different subsets of image signals generated by an image generator and distributed to the display devices by one or more display drivers. The electronic devices have a closed configuration in which one or more of the displays are, for example, stowed away, e.g., folded together, to facilitate the portability and/or storage of the electronic device.

[0006] A display driver is a component that provides an interface between an image generator and a display device, whereby the display driver receives image signals or image generation commands from the image generator and, if necessary, processes those signals/commands to generate the signals for display by the display device. This processing may include such image processing functions as color format transformations and image scaling. A display driver may be implemented in any suitable combination of hardware and software.

[0007] Figs. 1(a) and 1(b) show perspective views of a portable electronic device **100** that functions as a combined cellular phone / personal digital assistant, according to one embodiment of the present invention. Fig. 1 (a) shows device **100** in its closed configuration, while Fig. 1(b) shows device **100** in a partially open configuration.

[0008] Device **100** has three distinct displays **102**, **104**, and **106**. Display **102** displays images when device **100** is in its closed configuration in which device **100** operates as a cellular phone. In this configuration, display **102** is able to display conventional text and/or graphical images associated with sending and receiving telephone calls using a cellular phone.

[0009] Displays **104** and **106** display images when device **100** is in its open configuration in which device **100** operates as a personal digital assistant (PDA). According to one embodiment of the present invention, each of displays **104** and **106** displays part, e.g., half, of each PDA image. In the open configuration, displays **104** and **106** are positioned next to each other and display drivers in device **100** divide images for display on the two displays. The image thus displayed overflows from one display to the other, giving the appearance of a single large

display displaying the full image. The multiple small displays combine to simulate the operations of a single large display. As such, device **100** is able to present concurrently more useable information to the user than would otherwise be available to a user of a conventional PDA that had a single small display.

[0010] Displays **104** and **106** may be any suitable type of display device, including liquid crystal displays (LCDs). In device **100**, a hinge or other similar mechanism may be used to keep the displays together when used in the open, e.g., active, configuration or the closed, e.g., inactive, configuration. A locking mechanism can be used to keep the combined structure rigid when the screens are unfolded. As shown in Fig. 1(b), the different displays need not be co-planar in order for the device to be used in the active configuration.

[0011] Device **100** has two flat-panel displays **104** and **106** which may be less than 5mm thick without a backlight. When the device is in its inactive configuration, the two sides are folded together. For example, if a 5"x5" display area is implemented using two 5"x2.5" displays, the two displays are stored flat against each other. The inactive area is therefore only half of the active area, resulting in a more compact configuration for carrying and/or storing the device.

[0012] Fig. 1(c) shows a perspective view of a portable electronic device in the open configuration, according to an alternative embodiment of the present invention. According to this embodiment, display **102** of Fig. 1(a) and display **104'** of Fig. 1(c) are positioned back-to-back within the top half of the device. In one implementation of this embodiment, the device has backlighting means located behind display **106'**, and displays **106'** and **104'** are transparent. For such an implementation, the backlighting means behind display **106'** will illuminate display **102** when the device is in the closed configuration as shown in Fig. 1(a). In this way, a thinner device with backlighting can be achieved. Furthermore, in certain embodiments, display **102** of Fig. 1(a) and display **104'** of Fig. 1(c) may be implemented as a single display device that is adapted to generate images for both the open and closed configurations and possibly at the same time.

[0013] Fig. 2 shows a block diagram of an electronic device **200**, according to one implementation of the present invention. For example, electronic device **200** may be modified as needed to implement device **100** of Figs. 1(a)-(b). Device **200** has two or more display devices that may be used to display different sets of image signals to create the effect of a larger display.

[0014] In particular, image generator **206** generates image signals for display on display devices **210**. The image signals may comprise any conventional type of image signals, including text, video, graphics, or any combination thereof. Display driver **208** receives the image signals from image generator **206** and distributes appropriate subsets of image signals to the various display devices **210** for display. Each display device **210** operates as a distinct image display device. The effect however of all of the display devices **210** operating together under the control of display driver **208** is the simulation of a larger display device displaying all of the image signals generated by image generator **206**. Image generator **206** and display driver **208** may be implemented on a single processor, either in hardware, in software, or in a combination of both hardware and software.

[0015] Electronic device **200** also has optional local input device **202** and optional remote input device **204**. Local input device **202** may be any suitable device that enables a user to enter information into device **200**, such as a keyboard, a keypad, a stylus for a touch screen, a thumb wheel for scrolling, or a track pad. This information is received by image generator **206** for appropriate updating of the image signals to be displayed. Remote input device **204** may be an antenna, network, or cable port, or other suitable type of interface for receiving information from a remote source. This information is also received by image generator **206** for the update of the images to be displayed. In particular implementations, one or more of the display devices may be touch sensitive to operate as additional input devices of device **200** for the input of user-selected information to be fed back to image generator **206**.

[0016] Fig. 3 shows a block diagram of an electronic device **300**, according to an alternative implementation of the present invention. Electronic device **300** is analogous to electronic device **200** of Fig. 2, except that each display device **210** in device **300** has its own display driver **308** to control the display of subsets of image signals. Image generator **306** and display drivers **308** may be implemented on a single processor, either in hardware, in software, or in a combination of both hardware and software.

[0017] Depending on the implementation, the function of dividing image signals into subsets for display on the various display devices may be performed by either the image generator or the one or more display drivers. Even in device **300** of Fig. 3, where each display driver **308** interfaces with only a single display device, image generator **306** could generate and store the image signals into memory, and each display driver **308** could know which subset of those image signals to retrieve from memory. In any case, the image signals are divided into subsets based on the portions of each image displayed by the various display devices. For example, in the embodiment of Fig. 4, where the display devices display the top and bottom halves of each image, respectively, the image signals are divided into two subsets accordingly. Similarly, in the embodiment of Fig. 6, where the display devices display the top half, lower left quarter, and lower right quarter of each image, respectively, the image signals are divided into three subsets accordingly.

[0018] Figs. 4-6 shows portable electronic devices, according to possible embodiments of the present in-

vention. In Fig. 4, the portable electronic device has two displays that are shown in the full open configuration. In Fig. 5, the portable electronic device is shown configured with its two displays separated.

[0019] In Fig. 6, the portable electronic device has three separable displays. As mentioned above, in some implementations of the present invention, one or more of the display devices may operate as touch-type input devices. In these implementations, parts of one or more of the display devices could be used as a soft keyboard in which a keyboard is displayed on the screen and the user "types" by touching the screen at the appropriate locations. The touch membrane detects the locations where the user types and infers which characters are being typed. In one embodiment of the present invention, one of the multiple display devices may be a touch-type device that provides the soft keyboard. In an alternative embodiment, two such display devices may be used: one providing the left-hand portion of the soft keyboard and the other providing the right-hand portion of the soft keyboard. These display devices may be able to be positioned in different orientations, as selected by the user. Moreover, the display devices may be able to be physically separated from one another, as shown in Fig. 6. For example, in the application as a soft keyboard, the left- and right-hand touch screens may be separated to suit the user's ergonomic preferences. These touch screens may be stowed away when the electronic device is in the closed configuration.

[0020] In some embodiments of the present invention, the electronic devices support an alternative mode of operation in which two or more of the multiple displays can operate as distinct displays that display different images rather than different parts of the same images.

[0021] Although the present invention is particularly suitable for portable electronic devices, such as personal digital assistants, cellular telephones, internet access devices, palmtop computers, and laptop computers, those skilled in the art will understand that the present invention may be applied to other types of electronic devices as well, including stationary computer terminals.

[0022] It will be further understood that various changes in the details, materials, and arrangements of the parts which have been described and illustrated in order to explain the nature of this invention may be made by those skilled in the art without departing from the principle and scope of the invention as expressed in the following claims.

Claims

1. An electronic device comprising:

   (a) an image generator adapted to generate image signals;
   (b) one or more display drivers, connected to the image generator and adapted to receive the image signals from the image generator; and
   (c) two or more distinct display devices, connected to the one or more display drivers, wherein the electronic device has (1) an open configuration in which each display device is deployed for displaying a different subset of the image signals and (2) a closed configuration in which one or more of the display devices are stowed away and unavailable for displaying image signals.

2. A method for processing image signals using an electronic device, comprising the steps of:

   (a) generating the image signals; and
   (b) distributing different subsets of the image signals for display on two or more distinct display devices, wherein the electronic device has (1) an open configuration in which each display device is deployed for displaying a different subset of the image signals and (2) a closed configuration in which one or more of the display devices are stowed away and unavailable for displaying image signals.

3. An apparatus for processing image signals using an electronic device, comprising:

   (a) means for generating the image signals; and
   (b) means for distributing different subsets of the image signals for display on two or more distinct display devices, wherein the electronic device has (1) an open configuration in which each display device is deployed for displaying a different subset of the image signals and (2) a closed configuration in which one or more of the display devices are stowed away and unavailable for displaying image signals.

4. The device of claim 1, the method of claim 2 or apparatus of claim 3, wherein the electronic device is a portable electronic device.

5. The device of claim 1, or the method of claim 2. or apparatus of claim 3, wherein the display devices comprise a first touch-type display device adapted to display a left-hand side of a soft keyboard and a second touch-type display device adapted to display a right-hand side of the soft keyboard.

6. The device, method or apparatus of claim 3, wherein the first touch-type display device is separable from the second touch-type display device to allow the user to select relative positions for the left- and right-hand sides of the soft keyboard.

7. The device of claim 1 or the method of claim 2, or

apparatus of claim 3, wherein at least one display device can be used to display images in the closed configuration.

8. The device of claim 1 or the method of claim 2, or apparatus of claim 3, comprising one display driver for each or some or all of the display devices.

9. The device of claim 1 or the method of claim 2, or apparatus of claim 3, wherein the image generator and the one or more display drivers are implemented on a single processor.

10. The device of claim 1 or the method of claim 2, or apparatus of claim 3, wherein the one or more display drivers are implemented in software, or hardware.

11. An electronic device comprising first and second displays oppositely oriented, such that:

when the device is in a closed configuration, the first display is visible to a user and the second display is hidden from view; and
when the device is in an open configuration, the second display is visible to the user.

12. The device of claim 11, further comprising a third display, such that, when the device is in the open configuration. the second and third displays display different subsets of image signals.

13. The device of claim 11, wherein the first and second displays are mounted back-to-back and further comprising backlighting means located behind the third display, such that, when the device is in the closed configuration, the backlighting means is adapted to illuminate the first display.

14. The device of claim 11, wherein:

when the device is in the open configuration, the device is adapted to operate as a personal digital assistant; and
when the device is in the closed configuration, the device is adapted to operate as a portable telephone.

15. The device of claim 11, wherein the first and second displays are implemented as a single display device adapted to generate images for both the open and closed configurations.

FIG. 1A

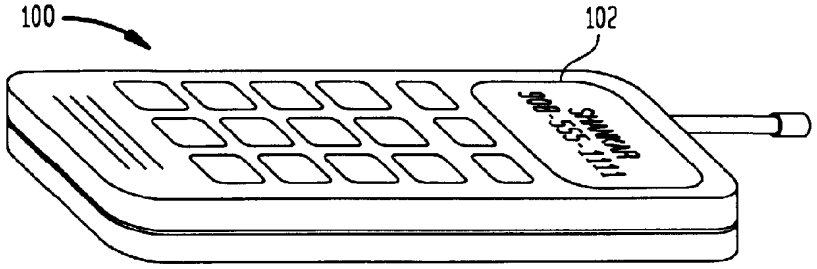


FIG. 1B

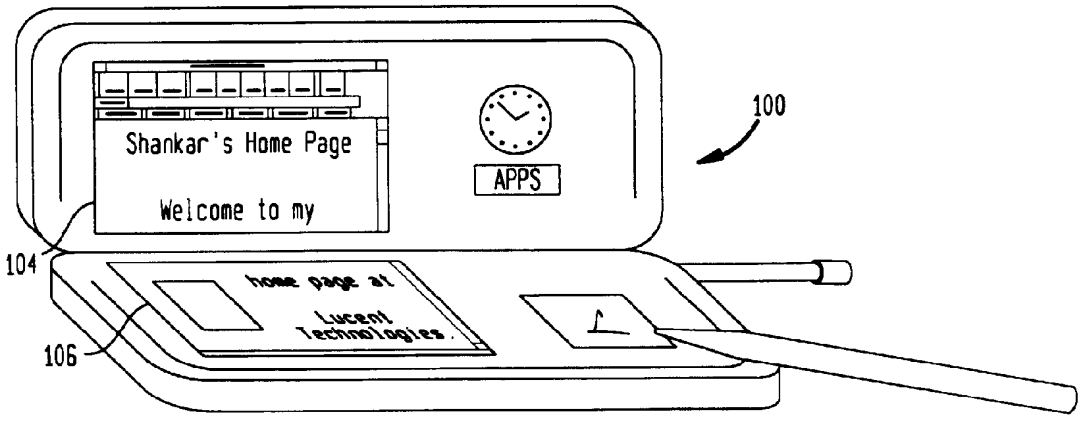


FIG. 1C

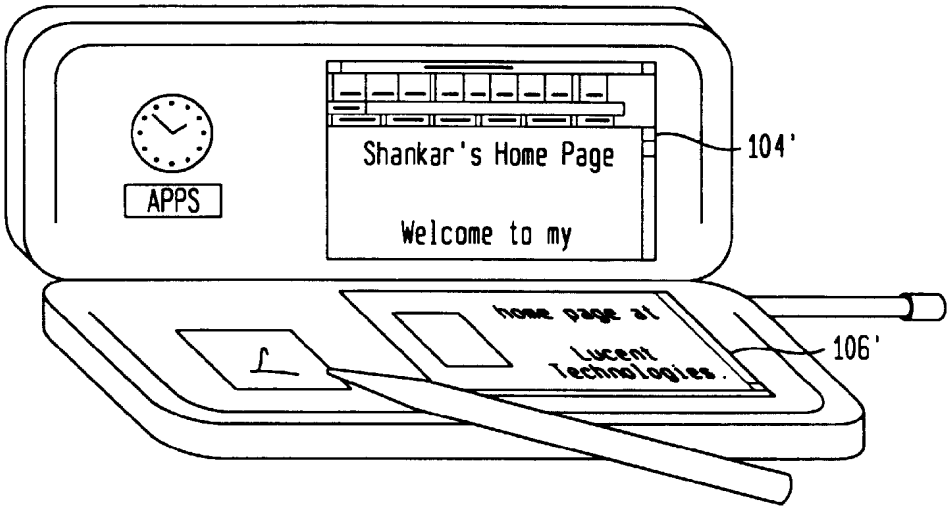

APPS
Shankar's Home Page
Welcome to my
104'
106'

FIG. 2

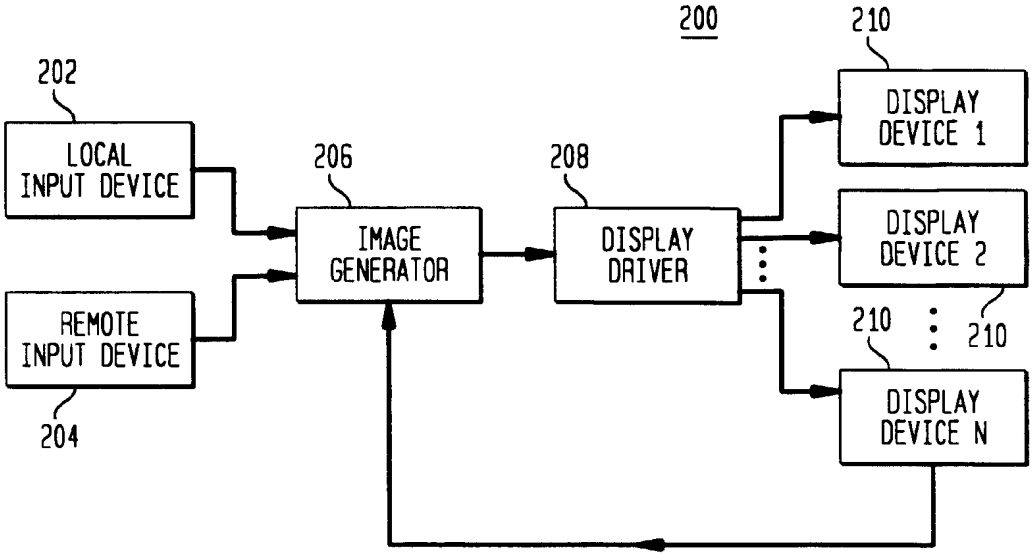

200
202
LOCAL INPUT DEVICE
REMOTE INPUT DEVICE
204
206
IMAGE GENERATOR
208
DISPLAY DRIVER
210
DISPLAY DEVICE 1
DISPLAY DEVICE 2
DISPLAY DEVICE N

FIG. 3

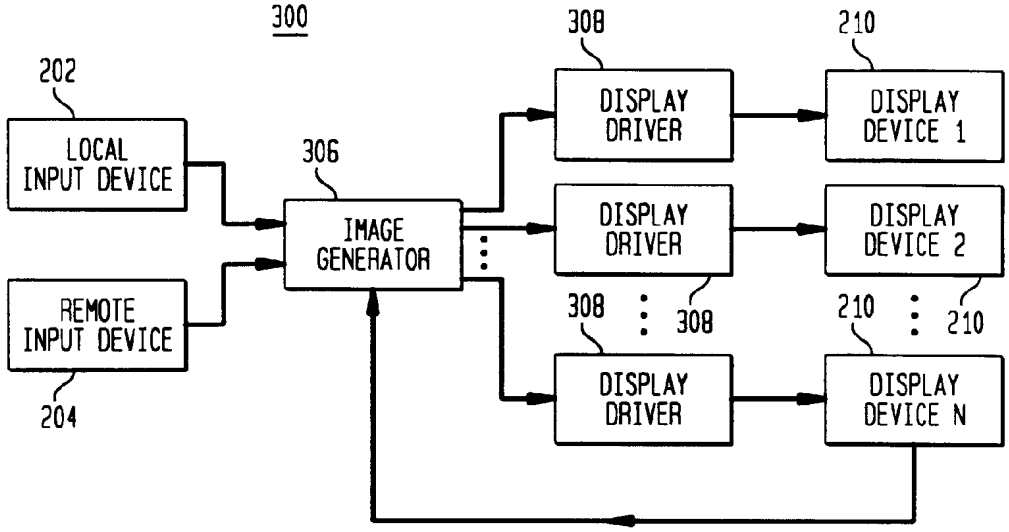

300
202
LOCAL INPUT DEVICE
REMOTE INPUT DEVICE
204
306
IMAGE GENERATOR
308
DISPLAY DRIVER
DISPLAY DRIVER
308
DISPLAY DRIVER
210
DISPLAY DEVICE 1
DISPLAY DEVICE 2
210
DISPLAY DEVICE N

FIG. 4

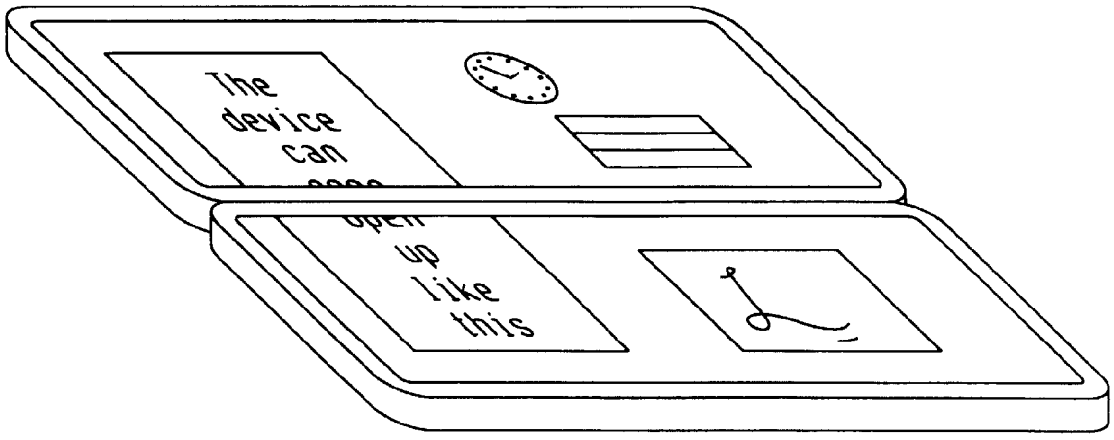

The device can
like this

FIG. 5

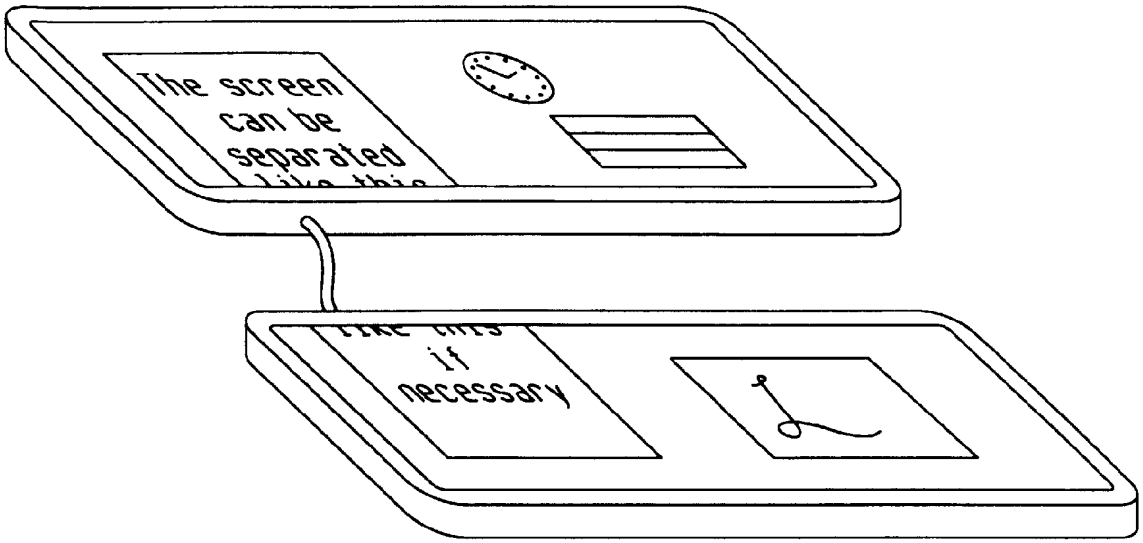


FIG. 6